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BUREAU OF PLANT INDUSTRY—Circular No. 13.
B. T. GALLOWAY, Chief of Bureau.

THE WORK OF THE SAN ANTONIO EXPERIMENT FARM IN 1907.

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THE WORK OF THE SAN ANTONIO EXPERIMENT FARM IN 1907.[a]

INTRODUCTION.

Although San Antonio is one of the oldest cities in the State of Texas, agriculture in its vicinity has not been continuously successful except with irrigation. To observers acquainted with semiarid conditions in other States, the amount of rainfall, the soil, and other natural conditions indicate that this section should be well adapted to dry farming. The rainfall, were it well distributed, would be sufficient for bountiful crops, but a large part of the water is lost through surface run-off, since much of the rain comes in violent storms and does not penetrate readily into the heavy soils that are characteristic of the region. Severe droughts occurring at irregular intervals and alternating with periods of excessive rainfall have seriously hampered agricultural development.

The farms near this city that have irrigation facilities produce abundant crops, showing that the soil is not lacking in fertility. The further extension of agriculture in Bexar County and surrounding counties depends more than anything else upon catching and holding the rain that falls. The soil must be tilled in such a manner as to permit the rapid absorption of the rain, and the best methods to prevent the loss of water by evaporation must be used.

The San Antonio Experiment Farm of the Bureau of Plant Industry was established in order to test the practical utility of various tillage methods, and also for the purpose of testing varieties of field

[a] Since July, 1904, the Bureau of Plant Industry has been operating an experiment and demonstration farm near San Antonio, Tex. The farm, which consists of 125 acres, is owned by the city of San Antonio and its use is given to this Bureau without charge. The buildings and permanent improvements were furnished by local subscription through the Business Men's Club of San Antonio. The aim of the Bureau's work on this farm has been to ascertain and demonstrate the tillage methods best suited to successful crop production in this region, which lies near the western and arid limit of the cotton belt, and also to experiment with new or little known crops that may be suited to this region. This circular is intended to give a brief and popular statement of the work of the farm for 1907.—B. T. Galloway, *Physiologist and Pathologist and Chief of Bureau.*

crops and fruits in order to determine those best adapted to the climatic and soil conditions of this section. In connection with these variety-testing experiments many trees, shrubs, and field crops imported from foreign countries are being grown.

LINES OF WORK UNDERTAKEN.

The following are the most important lines of work under way, a large part of which is in cooperation with other offices of the Bureau of Plant Industry: Tillage experiments, rotation experiments, cultural experiments with cotton, finding a method of eradicating Johnson grass; acclimatizing weevil-resisting types of cotton, in cooperation with the Office of Bionomic Investigations; tests of forage crops, in cooperation with the Office of Forage Crop Investigations; tests of grain crops, in cooperation with the Office of Grain Investigations; investigating the cause of the sterility of sorghum, in cooperation with the Agronomist in Charge of Grain-Sorghum Investigations; and tests of horticultural crops, in cooperation with the offices of Seed and Plant Introduction and of Field Investigations in Pomology.

TILLAGE EXPERIMENTS.

The soils in the vicinity of San Antonio are mostly heavy clay and so compact that they absorb water very slowly. To make them more open and porous, several methods of tillage not ordinarily practiced by farmers are being tried. The more important features of the methods tested last year were deep plowing, plowing in early autumn rather than in the spring, the addition of manure or other organic matter, and the maintenance of a dust mulch.

DEEP PLOWING AND SUBSOILING.

Deep plowing and subsoiling loosen the soil to a depth of 12 inches or more, so that both water and air can easily enter. In addition to catching more of the rainfall, the subsoiled ground allows a deeper and more healthy growth of the roots of plants. In experiments with cotton and corn in 1907 four plots of subsoiled ground yielded more in every case than an equal number of plots not subsoiled. A series of moisture determinations made during the growing season failed to show any appreciable difference, however, in the moisture condition of the two series of plots.

It costs almost twice as much to plow and subsoil land as it does to plow it alone. The results so far obtained are not adequate to serve as a basis for an estimate as to whether this increase in yield is sufficient to repay the additional cost of subsoiling. There is reason to believe, however, that the effects of subsoiling may be evident in crops for several years.

EARLY FALL PLOWING.

It has been common experience in semiarid farming that, where it can be done, early fall plowing gives better results than plowing in the spring immediately before planting, yet this practice is by no means generally followed in the vicinity of San Antonio. It takes an extra amount of power to plow the land when it is hard and dry, as it usually is in the late summer after crops have matured, so that the temptation is strong to put off plowing until the ground has been softened by rain. When rain falls on hard, unplowed ground much more of it is lost by surface run-off than when it falls on loose, plowed land. For this reason fall-plowed land usually shows a greater soil moisture content than spring-plowed land.

In October, 1907, a portion of a field of sorghum was plowed, the other part being left unplowed until December. In the mean time more than 7 inches of rain had fallen, and soil moisture determinations made in December showed that in the first 3 feet of the land plowed in October there was 24.9 per cent of water, while the land plowed in December contained for the same depth 22.6 per cent. This was a saving equivalent to 1.1 inches of rain actually absorbed and held as a result of the earlier plowing.

There are, of course, many local factors that must be taken into account in determining the best time to plow in any region. The important thing is that when the land is not actually in crop the surface should be kept in the best possible condition to absorb and retain any rain that falls. This is not merely good farm practice; it is absolutely necessary to insure crop production in the San Antonio region.

MANURING.

Either the application of barnyard manure or the plowing under of green crops, besides increasing the soil fertility, has a tendency to loosen the soil and to put it into much better condition for the absorption and retention of water. It is true that a heavy dressing of stable manure apparently dries out the soil, particularly if the manure is coarse. This is because such manure both ventilates the soil and actually absorbs water from it. This effect is immediate but not permanent. Although it may dry out the soil to some extent at first, at the same time the manure puts it into better condition for the absorption of moisture. When heavy rains fall upon manured land it may accumulate more moisture than unmanured land.

This peculiarity of manure to at first dry out the soil makes it quite necessary in a dry climate to apply it in the fall or early winter rather than in the spring. Bad effects from drought are likely to follow if the manure be added but a short time before seeding.

THE DUST MULCH.

Direct evaporation from the soil can be checked by keeping the upper 2 or 3 inches of the surface well cultivated, so as to form a dust blanket, or dust mulch. When the ground is kept covered with a thick layer of dry, loose soil, evaporation is slight, but when the soil surface is not kept dry and loose, evaporation goes on very rapidly. The tools required for maintaining the dust mulch are a common harrow, a weeder, and various forms of cultivators. The fact that the soil in the vicinity of San Antonio is heavy, together with the comparative rarity of high winds, makes it possible to maintain an effective dust mulch and to accumulate in the soil enough moisture to carry a crop to maturity even if little rain falls during its growth.

After the dust mulch has been destroyed by a rain, evaporation from the supply of water in the soil begins as soon as the rain ceases, and in cases where the weather immediately following the rain is hot and windy this loss of moisture becomes exceedingly great. On the heavy soils of San Antonio a light rain, as for instance 0.1 to 0.4 inch, reduces rather than increases the total amount of soil water. This is apparently due to the fact that such light rains are only sufficient to establish capillary connection between the surface soil and the moisture in the lower soil, and before the surface is dry enough to permit cultivation some of the moisture has been drawn from the supply below and dissipated into the air. A rain of less than 0.1 inch is usually insufficient to establish such capillary connection, and is therefore harmless. Even a heavy rain, unless followed immediately by cultivation to renew the dust mulch, may result in a reduction rather than in an increase of the amount of soil moisture. Such a case is illustrated by Table I.

TABLE I.—*Soil moisture in an orchard and a cornfield cultivated on June 5 and June 3, 1907, respectively, illustrating the effect of early tillage after rain.*

Depth in feet.	Orchard.		Cornfield.	
	Moisture, May 28.	Moisture, June 6.	Moisture, May 28.	Moisture, June 6.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1	22.3	22.2	18.3	20.0
2	21.2	21.2	18.4	18.6
3	19.6	17.8	15.6	15.3
Average	21.0	20.4	17.4	18.0

On May 29, 1.2 inches of rain fell, which should have raised the moisture content of the upper 3 feet of soil 2.7 per cent had it all been absorbed. Seven days after the rain, in the absence of a dust mulch, the moisture content of the first 3 feet in the orchard was 0.6 per cent less than it had been before the rain. Had this field been

harrowed two or three days after the rain there would have been an increase in the amount of water in the soil instead of an actual decrease. In a near-by field of corn which was cultivated two days earlier than the orchard there was an increase of 0.6 per cent of moisture over what was in the soil May 28.

WINTER TILLAGE.

Not only is it important to keep a well-established dust mulch on all cultivable land throughout the summer, but effective measures should be taken to catch and hold all the moisture possible that may fall during the winter. In cold climates, where the soil remains frozen, but little tillage can be given. The San Antonio climate, however, is comparatively warm in winter, so that much soil moisture may be lost by evaporation unless the ground is harrowed or cultivated so as to establish a dust mulch after rains.

The usual method is to stir the surface of the ground as soon as it can be worked after each rain. Winter harrowing of fallow land may seem to be an expensive operation, but in this region it is very likely to make the difference between success and failure, and the expense is really not very great where proper tools are used.

Table II shows the results of soil-moisture determinations made on March 12, 1908, on two fields, one of which was fall-plowed and kept well tilled throughout the winter and the other plowed in February. These plots bore the same kind of a crop in 1907, and the moisture condition in the autumn was probably alike in both. It will be noted that the upper foot of soil of the winter-tilled plot retained 3.4 per cent more moisture than the plot that was left without cultivation until February.

TABLE II.—*Soil moisture on March 12, 1908, in two fields at San Antonio, Tex., one of which was plowed during the previous autumn and the other in the preceding month.*

Depth in feet.	Fall-plowed field.	Spring-plowed field.	Difference.
	Per cent.	*Per cent.*	*Per cent.*
1	25.8	22.4	3.4
2	21.3	20.5	0.8
3	19.4	18.9	0.5
Average	22.2	20.6	1.6

ROTATION OF CROPS.

There are few subjects so much discussed in the agricultural papers and at the same time so little understood as the rotation of crops. It has long been known that continued use of the land for a single crop

finally results in reduced yields, and it is also generally recognized that alternating two or more crops gives better results than when but one is grown continuously.

To find the rotations best suited to any given agricultural region is a very complex undertaking and one that takes many years to accomplish. To find suitable rotations it is necessary to determine the crops that can be most profitably grown, the order in which they should follow each other, and the tillage methods most successful in securing high yields. The effect of the entire system of rotations, combined with the best tillage methods, should be to maintain or increase the soil fertility. Establishing rotations in the semiarid regions is complicated by the fact that they must be adapted to the conservation of soil moisture.

For successful farming in the region of San Antonio not only must the best methods known be used for saving the soil moisture, but it is also important that proper rotation of crops be followed if high productiveness is to be maintained. In order to find practical rotations that will keep the soil in condition to give the maximum yields, about forty rotations have been planned and are now being carried on at the experiment farm.

To show the method of procedure the following examples are given:

Rotation A.	Rotation B.	Rotation C.
Oats and vetch.	Oats and vetch.	Oats and vetch, followed by cowpeas.
Cotton.	Cotton.	Cotton.
Corn.	Corn, manured.	Corn, manured.

It will be noticed that only one factor is changed for each rotation. Rotations A and B differ only in the fact that the corn is manured in the latter. After a series of years the results of the manuring should be apparent on all of the crops in Rotation B, and the effect of this manure can be determined by comparing the yields in B with A. Likewise, the effect of the cowpeas on the yields of the crops in Rotation C can be determined by comparing C with B.

In the same way, by changing one factor at a time in the rotation, we may compare the effects of deep and shallow plowing, of fall and spring plowing, and may determine the value of disking and the effect of plowing under green crops.

The rotation experiments have been but recently started and it is still too early to draw conclusions as to the results, but it seems certain that the differences in yields will be brought out more and

more distinctly in the years that follow, and the rotations best suited to the region will be shown.

METHODS OF PREVENTING STERILITY IN SORGHUM.[a]

Sorghum is one of the commonest forage crops grown in the vicinity of San Antonio, and such varieties as milo and kafir thrive well there and would be profitable as grain crops were it not for the fact that they can not be depended upon to produce seed. It has been generally supposed that unfavorable weather conditions at flowering time was the cause of sterility, which is often complete. The true explanation of this sterility was not discovered until the season of 1907, when a special study was made of the problem at a number of places, including the San Antonio Farm. An elaborate series of experiments was planned, which included planting sorghums at regular intervals during the season and a close study of the weather conditions at flowering time.

It was found, however, that it was not the climate that caused the sterility, but that it was due to the activities of certain minute red-bodied flies (*Diplosis sorghicola*) that infested the sorghum heads at the time the flowers opened. These insects lay their eggs in the blossoms; from these eggs tiny maggots hatch out, one in each flower, and during their growth these maggots absorb the substance of the newly formed seed. In fourteen or sixteen days after the eggs are laid these maggots have, in turn, become mature flies. No practical remedy has yet been found for combating the work of this insect, although it is quite possible to secure seed by covering the sorghum heads with paper bags before the flowers open.

Further investigations concerning the sorghum midge are being carried on and it is hoped that some practicable method of combating it may be discovered.

ERADICATION OF JOHNSON GRASS.[b]

Johnson grass (*Andropogon halepensis* Brot.), which may be either a valuable forage crop or a pernicious weed, depending upon how it is controlled, is an important feature of the agriculture near San Antonio. This grass perpetuates and spreads itself not only by seed but by rootstocks sent out beneath the surface of the soil. These rootstocks are capable of sending up a new plant at each joint. It is on this account that the grass is so difficult to exterminate, and any

[a] For a more detailed report on this subject, see "The Sorghum Midge," by Carleton R. Ball, "Science," n. s., vol. 27, pp. 114–115, January 17, 1908.

[b] For another method of eradication, see Farmers' Bulletin No. 279, entitled "A Method of Eradicating Johnson Grass."

method of getting rid of it must be one that will prevent the formation of new rootstocks. It has been found by observing the habits of the plant that new rootstocks do not form until the plant is 6 or 8 inches high or is ready to head out. It is obvious, therefore, that if the plant is never allowed to attain a greater development than this it must die as soon as the last joint of the old rootstock has sprouted or decayed.

In the spring of 1906 work was begun to eradicate the Johnson grass that wholly covered a large part of the farm and that occurred sporadically on the remainder. At first, attempts were made to rake the roots into windrows on the surface and burn them, but this method proved more expensive and less effective than persistent cultivation. It was found that a quicker plan of eradication was to cut the grass off below the surface of the ground as often as it attained a height of 6 or 8 inches.

In killing out a meadow, the best results were obtained by plowing the land shallowly in September and sowing to winter oats. During the winter while the grass is dormant the oats reduce the moisture content of the soil, so that in the spring when they are cut for hay the ground is left comparatively dry. The resulting growth of the Johnson grass is not so vigorous as on fields left fallow during the winter and is kept down with greater ease by the cultivation following the removal of the crop.

In September, 1906, a 6-acre field of Johnson grass meadow was plowed 4 to 5 inches deep with a disk plow. In November the field was divided into two parts, A and B.

Field A contained 2 acres and was left fallow during the winter. The cultivation required to keep down the Johnson grass during the months of February, March, and April cost $10.84 per acre for man and horse labor, which is rather too expensive for general practice. In May, when the eradication was nearly complete, this field was sown to German millet.

Field B, containing 4 acres, was sown to oats in November. In the spring the Johnson grass grew very vigorously in Field A, but the growth in the oats in Field B was weak, and but few plants headed out before harvesting, which was early in May. The field was plowed again in June at a cost of $2.73 per acre, but this should not be charged against the cost of eradicating the grass, since it left the field in excellent condition for the following crop. The cost of cultivation to eradicate the Johnson grass after plowing was only $1.12 per acre.

The above treatments were equally efficient in eradicating the grass, but the difference in cost was entirely in favor of the second method given.

The most useful implement for this work is a 2-horse 6-shovel cultivator with sweep attachments. A small 1-horse cultivator with similar sweeps does as good work as the large one, but is of course more expensive, since one man can not accomplish as much in a day. When the grass occurs only in small scattered spots, cultivation of the whole field becomes unnecessary. These spots can be cleaned up by keeping the grass cut down with a garden hoe. Digging out the roots in such spots (a plan followed by some farmers) is no more effective than cutting off the plants and is much more laborious and expensive.

In attempting to eradicate Johnson grass by any method the work must be thoroughly done, for if any plants be allowed to approach maturity all the previous work is lost. Thorough cultivation will kill out the grass. Careless cultivation makes it grow more vigorously.

CROPS FOR FORAGE AND GREEN MANURE.

There is a serious lack of suitable forage crops in the region about San Antonio. In the drier seasons not enough forage is produced to supply the local demand and it becomes necessary to have supplies brought in from outside sources. Such a condition is both undesirable and unnecessary and tends to cripple the dairying and stock-raising industries, which should flourish in this region.

Johnson grass, sorghum, and winter oats are at present the most prominent and profitable forage crops grown. While Johnson grass is a profitable crop when properly handled, it is a serious pest where not under control, and the danger of scattering it by feeding is so great that it is far from being a popular forage crop.

Winter oats make a very desirable feed, but do not seem to be ordinarily profitable enough to induce farmers to raise a sufficient quantity to supply the market.

Sorghum yields well and is fairly drought resistant, but it is so hard to cure that farmers do not grow it extensively. A number of experiments in methods of planting sorghum for forage have been tried. The results show that heavier yields are obtained, at least in the dry years, when the sorghum is drilled in rows far enough apart to allow cultivation. In 1907 a field of sorghum sown in the manner usually followed by the San Antonio farmers, that is, by broadcasting the seed, yielded 1.68 tons per acre, while the same variety of sorghum drilled in rows 4 feet apart in an adjoining plot yielded 2.9 tons of cured fodder per acre.

Sorghum grown in drilled rows has the disadvantage of producing a coarser fodder than when sown broadcast, but in spite of this the

total yield of digestible dry matter is much greater. When the sorghum is to be put on the market a readier sale may be found for the broadcasted sorghum on account of its finer quality, but for home consumption the drilled sorghum will be found to be the more profitable crop. When drilled, it may be cut with a corn binder and shocked by hand in the same manner as corn, so that little difficulty is experienced in curing it.

Vetches are winter annuals that may be grown alone or in mixture with oats. There are a few varieties that seem to be adapted to San Antonio conditions. The scarlet vetch (*Vicia fulgens*) is one of the most promising species so far tried. It is not certain yet that any of the vetches will prove profitable as a forage crop for San Antonio conditions, but they will certainly be valuable in rotation as winter annuals that will improve the soil and yield at least a small amount of forage. No yield tests of forage have yet been made, as all the better varieties under trial were allowed to mature in order to save the seed.

Many varieties of cowpeas have been tried. Some of them have proved to be fairly drought resistant and their culture is to be recommended. Cowpeas not only make a very nutritious hay, but, like the vetches, are of value in maintaining soil fertility. As the forage yield of cowpeas is not usually large they can not be recommended solely as a forage crop, but rather as a green manure crop to be used in the rotation for their beneficial effects upon the soil. The varieties that did best last year on the experiment farm were the Whippoorwill, Iron, and Clay. Some especially drought-resistant strains have been selected from among these varieties and are being propagated.

A newly introduced plant from India known as "guar" (*Cyamopis tetragonoloba*) has been found very drought resistant. It is a legume, having nitrogen nodules on the roots; hence, it will undoubtedly prove valuable in increasing the soil fertility. It can at present be recommended for planting only as a green manure crop or as forage for sheep, as other kinds of stock do not readily eat any of the varieties so far tested.

Several varieties of clover have been on trial, but so far none have proved to be sufficiently drought resistant to be of value. Rape was tried for two seasons, but both times it was killed out by the harlequin beetles, so that it can not be considered a success.

Alfalfa is not a successful crop in the vicinity of San Antonio when sown in the ordinary manner unless irrigated. In the spring of 1907, in cooperation with Mr. Charles J. Brand, of the Office of

Plant Life History Investigations, 1.28 acres were planted to alfalfa varieties in double-drilled rows 2 feet apart, so as to permit cultivation. These varieties survived the severe drought of the summer of 1907, and in March, 1908, the first cutting yielded 1,236 pounds of cured alfalfa hay from the field, a yield equivalent to 957 pounds to the acre. Adjacent plots sown in the ordinary manner—that is, in drills 6 inches apart—yielded at the same time at the rate of only 318 pounds to the acre.

This indicates that there is a possibility of growing alfalfa successfully near San Antonio without irrigation, if it be planted so as to permit intertillage. Experiments are now under way to determine the most practicable method of sowing this crop and of keeping down the weeds when the plants are young.

CROPS RAISED FOR GRAIN.

There is much need for more grain crops in the vicinity of San Antonio. At present not enough grain is raised to supply the local demand. There is no apparent reason why some varieties of grain should not prove successful in this region, for the average rainfall is decidedly more than that of some of the more important grain-producing regions. It is possible that the common failure of grain crops may be due to disease and not to the lack of moisture. In such a case it will become necessary to find and use the more disease-resisting varieties. Tests are now being made of a number of varieties of winter wheat, oats, barley, and rye, and these crops are being watched carefully to determine whether or not it is disease or insect pests that cause the comparative sterility and consequent low yields. No recommendation of varieties can yet be made.

As has already been pointed out, the use of varieties of sorghum for grain production is not now possible, owing to the ravages of the sorghum midge.

CULTURAL EXPERIMENTS WITH COTTON.

Two lines of work are being carried on with cotton. One is in connection with the tillage and rotation experiments, where yield tests of cotton are being made on a deep fall plowing compared with shallow fall plowing, deep spring plowing compared with shallow spring plowing, and manured land compared with unmanured land; also drill planting compared with check-row planting. In 1907 deep plowing yielded better than shallow plowing, fall plowing better than spring plowing, and manured land about the same as unmanured

land. Less definite results were obtained from the comparison of drilled and check-row planting, due to the poorer stand obtained from the hill planting, which was done by hand.

ACCLIMATIZATION OF WEEVIL-RESISTING TYPES OF COTTON.

Experiments are being made with a considerable series of the weevil-resisting varieties of cotton discovered in Central America by Mr. O. F. Cook.[a] These are being acclimatized and selected at San Antonio and in several other localities in Texas. The conditions at San Antonio enable the new varieties to display their drought-resisting qualities, which prove to be unusually high. They also show, in various degrees, the characters which give them protection against the weevils.

After being grown for two years at San Antonio some of the varieties remain nearly sterile, but others are rapidly increasing in fertility and have already overtaken most of the Upland varieties included in the test. Special attention is being given to the selection of a variety of cotton suited to San Antonio conditions by combining as much as possible of the three desirable qualities of large yield, weevil resistance, and drought resistance.

HORTICULTURAL WORK.

Tests are being made of the varieties of grapes, peaches, Japanese persimmons, apricots, apples, plums, figs, pistaches, olives, and a large number of new fruits and ornamental shrubs and trees that have been introduced by the Office of Seed and Plant Introduction. Altogether about 10 acres have been devoted to horticultural work. This line of work is of very great importance, for the tests thus far made indicate that there are many fruit crops well suited to San Antonio conditions. The fruit trees were too young to bear in 1907, but most of them should begin bearing in the near future.

Tree crops appear to be more especially adapted to dry-land culture than any of the general farm crops, because the trees are usually planted far apart and in such a manner as to permit cultivation of the land in two directions. Since nearly the entire surface of the ground can be easily kept covered with a dust mulch, the loss by evaporation from the soil surface is comparatively slight. Soil moisture determinations made during the dry months of 1906 and 1907 showed less

[a] "Weevil-Resisting Adaptations of the Cotton Plant." Bul. 88, Bureau of Plant Industry, U. S. Dept. of Agriculture.

loss of moisture in the orchards than in fields planted to any other crop.

There are over 400 seedling peaches on the farm raised from seeds collected in one of the dry-land fruit regions of Mexico by Mr. G. Onderdonk, of Nursery, Tex. These trees have been making rapid growth and are bearing fruit for the first time this season (1908). In this orchard of seedlings it is hoped that at least a few trees will be found that are well adapted to San Antonio conditions. Any trees that prove exceptionally valuable will be propagated for distribution.

The pistache is a nut-producing tree quite extensively grown in some parts of the Old World. The nut is valuable for the color and pleasing flavor it imparts to confections. All pistache nuts used in the United States at the present time are imported. Several hundred trees, embracing a number of wild species brought from parts of Europe, Asia, and Africa, are on trial at the experiment farm. They are hardy, have made good growth, and seem to stand drought well. This work with the pistache is conducted in cooperation with the Office of Plant Life History Investigations of the Bureau of Plant Industry.

CONCLUSIONS.

In the preceding pages the chief lines of work under way at the San Antonio Experiment Farm have been outlined, and some of the results obtained in 1906 and 1907 have been given. It must be borne in mind, however, that results obtained from the work of one or two years are hardly sufficient to serve as a basis for general conclusions. Such experiments must be carried on for several seasons and be subjected to diverse climatic conditions before the results can be considered reliable.

The chief aim of this circular is to set forth some of the agricultural problems of the San Antonio region and to show how the solution of these problems is attempted.

The crop year of 1907 was one of low rainfall, the total precipitation for the year ended September 1, 1907, being 20.37 inches, while the normal annual rainfall is 29.02 inches; yet the yields obtained on the experiment farm with cotton, sorghum, and corn show that even in the driest seasons fairly good crops can be raised when the best methods of tillage are followed.

A method of exterminating Johnson grass has been practiced successfully, and the cause of the failure of some sorghum varieties to set seed in this section has been discovered.

The satisfactory showing made by many of the varieties of fruit trees under trial would indicate the possibility of a considerable de-

velopment of fruit production without irrigation. The trees are still very young, however, and many difficulties now unforeseen may develop as they approach maturity.

Detailed investigations have been made as to the effectiveness of various tillage methods in conserving soil moisture and as to the moisture requirements of various crops.

Approved:

JAMES WILSON,

Secretary of Agriculture.

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